It would greatly add to the utility of the Faure battery if its weight and size could be considerably reduced, for in that case it might be applicable to many purposes of locomotion. We may easily conceive its becoming available in a lighter form for all sorts of carriages on common roads, thereby saving to a vast extent the labour of horses. Even the nobler animal that strides a bicycle, or the one of fainter courage that prefers the safer seat of a tricycle, may ere long be spared the labour of propulsion, and the time may not be distant when an electric horse, far more amenable to discipline than the living one, may be added to the bounteous gifts which science has bestowed on civilised man.

In conclusion I may observe that we can scarcely sufficiently admire the profound investigations which have revealed to us the strict dynamical relation of heat and electricity to outward mechanical motion. It would be a delicate task to apportion praise amongst those whose labours have contributed, in various degrees, to our present knowledge; but I shall do no injustice in saying that of those who have expounded the modern doctrine of energy, in special relation to mechanical practice, the names of Joule, Clausius, Rankine, and William Thomson, will always be conspicuous. But up to this time our knowledge of energy is almost confined to its inorganic aspect. Of its physiological action we remain in deep ignorance, and as we may expect to derive much valuable guidance from a knowledge of Nature's methods of dealing with energy in her wondrous mechanisms, it is to be hoped that future research will be directed to the elucidation of that branch of science which as yet has not even a name, but which I may provisionally term "Animal Energetics."

THE RISE AND PROGRESS OF PALÆONTOLOGY[1]

THAT application of the sciences of biology and geology which is commonly known as palæontology took its origin in the mind of the first person who, finding something like a shell or a bone naturally imbedded in gravel or in rock, indulged in speculations upon the nature of this thing which he had dug out—this "fossil"—and upon the causes which had brought it into such a position. In this rudimentary form, a high antiquity may safely be ascribed to palæontology, inasmuch as we know that, 500 years before the Christian era, the philosophic doctrines of Xenophanes were influenced by his observations upon the fossil remains exposed in the quarries of Syracuse. From this time forth, not only the philosophers, but the poets, the historians, the geographers of antiquity occasionally refer to fossils; and after the revival of learning lively controversies arose respecting their real nature. But hardly more than two centuries have elapsed since this fundamental problem was first exhaustively treated; it was only in the last century that the archæological value of fossils—their importance, I mean, as records of the history of the earth—was fully recognised; the first adequate investigation of the fossil remains of any large group of vertebrated animals is to be found in Cuvier's "Recherches sur les Ossemens Fossiles," completed in 1822; and, so modern is stratigraphical palæontology, that its founder, William Smith, lived to receive the just recognition of his services by the award of the first Wollaston Medal in 1831.

But, although palæontology is a comparatively youthful scientific speciality, the mass of materials with which it has to deal is already prodigious. In the last fifty years the number of known fossil remains of invertebrated animals has been trebled or quadrupled. The work of interpretation of vertebrate fossils, the foundations of which were so solidly laid by Cuvier, was carried on, with wonderful vigour and success, by Agassiz, in Switzerland, by Von Meyer, in Germany, and last, but not least, by Owen in this country, while, in later years, a multitude of workers have laboured in the same field. In many groups of the animal kingdom the number of fossil forms already known is as great as that of the existing species. In some cases it is much greater; and there are entire orders of animals of the existence of which we should know nothing except for the evidence afforded by fossil remains. With all this it may be safely assumed that, at the present moment, we are not acquainted with a tithe of the fossils which will sooner or later be discovered. If we may judge by the profusion yielded within the last few years by the Tertiary formations of North America, there seems to be no limit to the multitude of Mammalian remains to be expected from that continent, and analogy leads us to expect similar riches in Eastern Asia whenever the Tertiary formations of that region are as carefully explored. Again, we have as yet almost everything to learn respecting the terrestrial population of the Mesozoic epoch—and it seems as if the Western Territories of the United States were about to prove as instructive in regard to this point as they have in respect of Tertiary life. My friend Prof. Marsh informs me that, within two years, remains of more than 160 distinct individuals of mammals, belonging to twenty species and nine genera, have been found in a space not larger than the floor of a good-sized room; while beds of the same age have yielded 300 reptiles, varying in size from a length of 60 feet or 80 feet to the dimensions of a rabbit.

The task which I have set myself to-night is to endeavour to lay before you, as briefly as possible, a sketch of the successive steps by which our present knowledge of the facts of palæontology and of those conclusions from them which are indisputable has been attained; and I beg leave to remind you, at the outset, that in attempting to sketch the progress of a branch of knowledge to which innumerable labours have contributed, my business is rather with generalisations than with details. It is my object to mark the epochs of palæontology, not to recount all the events of its history.

That which I just now called the fundamental problem of palæontology, the question which has to be settled before any other can be profitably discussed, is this,—What is the nature of fossils? Are they, as the healthy common sense of the ancient Greeks appears to have led them to assume without hesitation, the remains of animals and plants? Or are they, as was so generally maintained in the fifteenth, sixteenth, and seventeenth centuries, mere figured stones, portions of mineral matter which have assumed the forms of leaves and shells and bones, just as those portions of mineral matter which we call crystals take on the form of regular geometrical solids? Or, again, are they, as others thought, the products of the germs of animals and of the seeds of plants which have lost their way, as it were, in the bowels of the earth, and have achieved only an imperfect and abortive development? It is easy to sneer at our ancestors for being disposed to reject the first in favour of one or other of the last two hypotheses; but it is much more profitable to try to discover why they, who were really not one whit less sensible persons than our excellent selves, should have been led to entertain views which strike us as absurd. The belief in what is erroneously called spontaneous generation—that is to say, in the development of living matter out of mineral matter, apart from the agency of pre-existing living matter, as an ordinary occurrence at the present day—which is still held by some of us, was universally accepted as an obvious truth by them. They could point to the arborescent forms assumed by hoar-frost and by sundry metallic minerals as evidence of the existence in nature of a "plastic force" competent to enable inorganic matter to assume the form of organised bodies. Then, as every one who is familiar with fossils knows, they present innumerable gradations, from shells and bones which exactly resemble the recent objects, to masses of mere stone which, however accurately they repeat the outward form of the organic body, have nothing else in common with it; and, thence, to mere traces and faint impressions in the continuous substance of the rock. What we now know to be the results of the chemical changes which take place in the course of fossilization, by which mineral is substituted for organic substance, might, in the absence of such knowledge, be fairly interpreted as the expression of a process of development in the opposite direction—from the mineral to the organic. Moreover, in an age when it would have seemed the most absurd of paradoxes to suggest that the general level of the sea is constant, while that of the solid land fluctuates up and down through thousands of feet in a secular ground swell, it may well have appeared far less hazardous to conceive that fossils are sports of nature than to accept the necessary alternative, that all the inland regions and highlands, in the rocks of which marine shells had been found, had once been covered by the ocean. It is not so surprising, therefore, as it may at first seem, that although such men as Leonardo da Vinci and Bernard Palissy took just views of the nature of fossils, the opinion of the majority of their contemporaries set strongly the other way; nor even that error maintained itself long after the scientific grounds of the true interpretation of fossils had been stated, in a manner that left nothing to be desired, in the latter half of the seventeenth century. The person who rendered this good service to palæontology was Nicholas Steno,

[1] Discourse given at the York meeting of the British Association by Prof. T. H. Huxley, Sec. R. S. Revised by the author.

professor of anatomy in Florence, though a Dane by birth. Collectors of fossils at that day were familiar with certain bodies termed "glossopetræ," and speculation was rife as to their nature. In the first half of the seventeenth century, Fabio Colonna had tried to convince his colleagues of the famous Accademia dei Lincei that the glossopetræ were merely fossil sharks' teeth, but his arguments made no impression. Fifty years later Steno re-opened the question, and, by dissecting the head of a shark and pointing out the very exact correspondence of its teeth with the glossopetræ, left no rational doubt as to the origin of the latter. Thus far, the work of Steno went little further than that of Colonna, but it fortunately occurred to him to think out the whole subject of the interpretation of fossils, and the results of his meditations was the publication, in 1669, of a little treatise with the very quaint title of "De Solido intra Solidum naturaliter contento." The general course of Steno's argument may be stated in a few words. Fossils are solid bodies which by some natural process have come to be contained within other solid bodies—namely, the rocks in which they are imbedded; and the fundamental problem of palæontology, stated generally, is this—"Given a body endowed with a certain shape and produced in accordance with natural laws, to find in that body itself the evidence of the place and manner of its production."[1] The only way of solving this problem is by the application of the axiom that "like effects imply like causes," or as Steno puts it, in reference to this particular case, that "bodies which are altogether similar have been produced in the same way."[2] Hence, since the glossopetræ are altogether similar to sharks' teeth, they must have been produced by shark-like fishes; and since many fossil shells correspond, down to the minutest details of structure, with the shells of existing marine or freshwater animals, they must have been produced by similar animals; and the like reasoning is applied by Steno to the fossil bones of vertebrated animals, whether aquatic or terrestrial. To the obvious objection that many fossils are not altogether similar to their living analogues, differing in substance while agreeing in form, or being mere hollows or impressions, the surfaces of which are figured in the same way as those of animal or vegetable organisms, Steno replies by pointing out the changes which take place in organic remains imbedded in the earth, and how their solid substance may be dissolved away entirely, or replaced by mineral matter, until nothing is left of the original but a cast, an impression, or a mere trace of its contours. The principles of investigation thus excellently stated and illustrated by Steno in 1669, are those which have, consciously, or unconsciously, guided the researches of palæontologists ever since. Even that feat of palæontology which has so powerfully impressed the popular imagination, the reconstruction of an extinct animal from a tooth or a bone, is based upon the simplest imaginable application of the logic of Steno. A moment's consideration will show, in fact, that Steno's conclusion that the glossopetræ are sharks' teeth implies the reconstruction of an animal from its tooth. It is equivalent to the assertion that the animal of which the glossopetræ are relics had the form and organisation of a shark; that it had a skull, a vertebral column, and limbs similar to those which are characteristic of this group of fishes; that its heart, gills, and intestines presented the peculiarities which those of all sharks exhibit; nay, even that any hard parts which its integument contained were of a totally different character from the scales of ordinary fishes. These conclusions are as certain as any based upon probable reasonings can be. And they are so, simply because a very large experience justifies us in believing that teeth of this particular form and structure are invariably associated with the peculiar organisation of sharks, and are never found in connection with other organisms. Why this should be we are not at present in a position even to imagine; we must take the fact as an empirical law of animal morphology, the reason of which may possibly be one day found in the history of the evolution of the shark tribe, but for which it is hopeless to seek for an explanation in ordinary physiological reasonings. Every one practically acquainted with palæontology is aware that it is not every tooth nor every bone which enables us to form a judgment of the character of the animal to which it belonged, and that it is possible to possess many teeth, and even a large portion of the skeleton of an extinct animal, and yet be unable to reconstruct its skull or its limbs. It is only when the tooth or bone presents peculiarities which we know by previous experience to be characteristic of a certain group that we can safely predict that the fossil belonged to an animal of the same group. Any one who finds a cow's grinder may be perfectly sure that it belonged to an animal which had two complete toes on each foot, and ruminated; any one who finds a horse's grinder may be as sure that it had one complete toe on each foot and did not ruminate; but, if ruminants and horses were extinct animals of which nothing but the grinders had ever been discovered, no amount of physiological reasoning could have enabled us to reconstruct either animal, still less to have divined the wide differences between the two. Cuvier, in the "Discours sur les Révolutions de la Surface du Globe," strangely credits himself, and has ever since been credited by others, with the invention of a new method of palæontological research. But if you will turn to the "Recherches sur les Ossemens Fossiles" and watch Cuvier, not speculating, but working, you will find that his method is neither more nor less than that of Steno. If he was able to make his famous prophecy from the jaw which lay upon the surface of a block of stone to the pelvis of the same animal which lay hidden in it, it was not because either he, or any one else, knew, or knows, why a certain form of jaw is, as a rule, constantly accompanied by the presence of marsupial bones—but simply because experience has shown that these two structures are co-ordinated.

[1] "De Solido intra Solidum," p 5.—"Dato corpore certâ figurâ prædito et juxta leges naturæ producto, in ipso corpore argumenta invenire locum et modum productionis detegentia."

[2] "Corpora sibi invicem omnino similia simili etiam modo producta sunt."

The settlement of the nature of fossils led at once to the next advance of palæontology—viz., its application to the deciphering of the history of the earth. When it was admitted that fossils are remains of animals and plants, it followed that, in so far as they resemble terrestrial or freshwater animals and plants, they are evidences of the existence of land or fresh water, and in so far as they resemble marine organisms, they are evidences of the existence of the sea at the time at which they were parts of actually living animals and plants. Moreover, in the absence of evidence to the contrary, it must be admitted that the terrestrial or the marine organisms implied the existence of land or sea at the place in which they were found while they were ye living. In fact, such conclusions were immediately drawn by everybody, from the time of Xenophanes downwards, who believed that fossils were really organic remains. Steno discusses their value as evidence of repeated alteration of marine and terrestrial conditions upon the soil of Tuscany in a manner worthy of a modern geologist. The speculations of De Maillet in the beginning of the eighteenth century turn upon fossils, and Buffon follows him very closely in those two remarkable works, the "Théorie de la Terre" and the "Époques de la Nature," with which he commenced and ended his career as a naturalist.

The opening sentences of the "Époques de la Nature" show us how fully Buffon recognised the analogy of geological with archæological inquiries. "As in civil history we consult deeds, seek for coins, or decipher antique inscriptions in order to determine the epochs of human revolutions and fix the date of moral events; so, in natural history, we must search the archives of the world, recover old monuments from the bowels of the earth, collect their fragmentary remains, and gather into one body of evidence all the signs of physical change which may enable us to look back upon the different ages of nature. It is our only means of fixing some points in the immensity of space and of setting a certain number of waymarks along the eternal path of time."

Buffon enumerates five classes of these monuments of the past history of the earth, and they are all facts of palæontology. In the first place, he says, shells and other marine productions are found all over the surface and in the interior of the dry land; and all calcareous rocks are made up of their remains. Secondly, a great many of these shells which are found in Europe are not now to be met with in the adjacent seas; and, in the slates and other deep-seated deposits, there are remains of fishes and of plants of which no species now exist in our latitudes, and which are either extinct or exist only in more northern climates. Thirdly, in Siberia and in other northern regions of Europe and of Asia, bones and teeth of ele, hants, rhinoceroses, and hippopotamuses occur in such numbers that these animals must once have lived and multiplied in those regions, although at the present day they are confined to southern climates. The deposits in which these remains are found are superficial, while those which contain shells and other marine remains lie much deeper. Fourthly, tusks and bones of elephants and hippopotamuses are found not only in the northern regions of the

old world, but also in those of the new world, although, at present, neither elephants nor hippopotamuses occur in America. Fifthly, in the middle of the continents, in regions most remote from the sea, we find an infinite number of shells, of which the most part belong to animals of those kinds which still exist in southern seas, but of which many others have no living analogues; so that these species appear to be lost, destroyed by some unknown cause. It is needless to inquire how far these statements are strictly accurate; they are sufficiently so to justify Buffon's conclusions that the dry land was once beneath the sea; that the formation of the fossiliferous rocks must have occupied a vastly greater lapse of time than that traditionally ascribed to the age of the earth; that fossil remains indicate different climatal conditions to have obtained in former times, and especially that the polar regions were once warmer; that many species of animals and plants have become extinct; and that geological change has had something to do with geographical distribution.

But these propositions almost constitute the framework of palæontology. In order to complete it but one addition was needed, and that was made, in the last years of the eighteenth century, by William Smith, whose work comes so near our own times that many living men may have been personally acquainted with him. This modest land surveyor, whose business took him into many parts of England, profited by the peculiarly favourable conditions offered by the arrangement of our secondary strata to make a careful examination and comparison of their fossil contents at different points of the large area over which they extend. The result of his accurate and widely-extended observations was to establish the important truth that each stratum contained certain fossils which are peculiar to it; and that the order in which the strata, characterised by these fossils, are superimposed one upon the other is always the same. This most important generalisation was rapidly verified and extended to all parts of the world accessible to geologists; and, now, it rests upon such an immense mass of observations as to be one of the best established truths of natural science. To the geologist this discovery was of infinite importance, as it enabled him to identify rocks of the same relative age, however their continuity might be interrupted or their composition altered. But to the biologist it had a still deeper meaning, for it demonstrated that, throughout the prodigious duration of time registered by the fossiliferous rocks, the living population of the earth had undergone continual changes, not merely by the extinction of a certain number of the species which at first existed, but by the continual generation of new species, and the no less constant extinction of old ones.

Thus, the broad outlines of palæontology, in so far as it is the common property of both the geologist and the biologist, were marked out at the close of the last century. In tracing its subsequent progress I must confine myself to the province of biology, and, indeed, to the influence of palæontology upon zoological morphology. And I accept this limitation the more willingly as the no less important topic of the bearing of geology and of palæontology upon distribution has been luminously treated in the address of the President of the Geographical Section.

The succession of the species of animals and plants in time being established, the first question which the zoologist or the botanist had to ask himself was, What is the relation of these successive species one to another? And it is a curious circumstance that the most important event in the history of palæontology which immediately succeeded William Smith's generalisation was a discovery which, could it have been rightly appreciated at the time, would have gone far towards suggesting the answer, which was in fact delayed for more than half a century. I refer to Cuvier's investigation of the Mammalian fossils yielded by the quarries in the older Tertiary rocks of Montmartre, among the chief results of which was the bringing to light of two genera of extinct hoofed quadrupeds, the *Anoplotherium* and the *Palæotherium*. The rich materials at Cuvier's disposition enabled him to obtain a full knowledge of the osteology and of the dentition of these two forms, and consequently to compare their structure critically with that of existing hoofed animals. The effect of this comparison was to prove that the *Anoplotherium*, though it presented many points of resemblance with the pigs on the one hand, and with the ruminants on the other, differed from both to such an extent that it could find a place in neither group. In fact, it held, in some respects, an intermediate position, tending to bridge over the interval between these two groups, which in the existing fauna are so distinct. In the same way, the *Palæotherium* tended to connect forms so different as the tapir, the rhinoceros, and the horse. Subsequent investigations have brought to light a variety of facts of the same order, the most curious and striking of which are those which prove the existence, in the mesozoic epoch, of a series of forms intermediate between birds and reptiles—two classes of vertebrate animals which at present appear to be more widely separated than any others. Yet the interval between them is completely filled, in the mesozoic fauna, by birds which have reptilian characters on the one side, and reptiles which have ornithic characters, on the other. So, again, while the group of fishes termed ganoids is at the present time so distinct from that of the dipnoi, or mudfishes, that they have been reckoned as distinct orders, the Devonian strata present us with forms of which it is impossible to say with certainty whether they are dipnoi or whether they are ganoids.

Agassiz's long and elaborate researches upon fossil fishes, published between 1833 and 1842, led him to suggest the existence of another kind of relation between ancient and modern forms of life. He observed that the oldest fishes presented many characters which recall the embryonic conditions of existing fishes; and that, not only among fishes, but in several groups of the invertebrata which have a long palæontological history, the latest forms are more modified, more specialised, than the earlier. The fact that the dentition of the older tertiary ungulate and carnivorous mammals is always complete, noticed by Prof. Owen, illustrated the same generalisation.

Another no less suggestive observation was made by Mr. Darwin, whose personal investigations during the voyage of the *Beagle* led him to remark upon the singular fact, that the fauna which immediately precedes that at present existing in any geographical province of distribution presents the same peculiarities as its successor. Thus, in South America and in Australia, the later tertiary or quaternary fossils show that the fauna which immediately preceded that of the present day was, in the one case, as much characterised by edentates and in the other by marsupials as it is now, although the species of the older are largely different from those of the newer fauna.

However clearly these indications might point in one direction, the question of the exact relation of the successive forms of animal and vegetable life could be satisfactorily settled only in one way—namely, by comparing, stage by stage, the series of forms presented by one and the same type throughout a long space of time. Within the last few years this has been done fully in the case of the horse, less completely in the case of the other principal types of the ungulata and of the carnivora, and all these investigations tend to one general result—namely, that in any given series the successive members of that series present a gradually increasing specialisation of structure. That is to say, if any such mammal at present existing has specially modified and reduced limbs or dentition and complicated brain, its predecessors in time show less and less modification and reduction in limbs and teeth and a less highly developed brain. The labours of Gaudry, Marsh, and Cope furnish abundant illustrations of this law from the marvellous fossil wealth of Pikermi and the vast uninterrupted series of tertiary rocks in the territories of North America.

I will now sum up the results of this sketch of the rise and progress of palæontology. The whole fabric of palæontology is based upon two propositions: the first is, that fossils are the remains of animals and plants; and the second is, that the stratified rocks in which they are found are sedimentary deposits; and each of these propositions is founded upon the same axiom that like effects imply like causes. If there is any cause competent to produce a fossil stem, or shell, or bone, except a living being, then palæontology has no foundation; if the stratification of the rocks is not the effect of such causes as at present produce stratification, we have no means of judging of the duration of past time, or of the order in which the forms of life have succeeded one another. But, if these two propositions are granted, there is no escape, as it appears to me, from three very important conclusions. The first is that living matter has existed upon the earth for a vast length of time, certainly for millions of years. The second is that, during this lapse of time, the forms of living matter have undergone repeated changes, the effect of which has been that the animal and vegetable population at any period of the earth's history contains some species which did not exist at some antecedent period, and others which ceased to exist at some subsequent period. The third is that in the case of many groups of mammals and some of reptiles, in which one type can be followed through a considerable extent of geological time, the series of different forms by which the type is represented at successive intervals of this time is exactly such as it would be if

they had been produced by the gradual modification of the earliest form of the series. These are facts of the history of the earth guaranteed by as good evidence as any facts in civil history.

Hitherto I have kept carefully clear of all the hypotheses to which men have at various times endeavoured to fit the facts of palæontology, or by which they have endeavoured to connect as many of these facts as they happened to be acquainted with. I do not think it would be a profitable employment of our time to discuss conceptions which doubtless have had their justification and even their use, but which are now obviously incompatible with the well-ascertained truths of palæontology. At present these truths leave room for only two hypotheses. The first is that, in the course of the history of the earth, innumerable species of animals and plants have come into existence, independently of one another, innumerable times. This, of course, implies either that spontaneous generation on the most astounding scale, and of animals such as horses and elephants, has been going on, as a natural process, through all the time recorded by the fossiliferous rocks; or it necessitates the belief in innumerable acts of creation repeated innumerable times. The other hypothesis is, that the successive species of animals and plants have arisen, the later by the gradual modification of the earlier. This is the hypothesis of evolution; and the palæontological discoveries of the last decade are so completely in accordance with the requirements of this hypothesis that, if it had not existed, the palæontologist would have had to invent it.

I have always had a certain horror of presuming to set a limit upon the possibilities of things. Therefore, I will not venture to say that it is impossible that the multitudinous species of animals and plants may have been produced one separately from the other by spontaneous generation, nor that it is impossible that they should have been independently originated by an endless succession of miraculous creative acts. But I must confess that both these hypotheses strike me as so astoundingly improbable, so devoid of a shred of either scientific or traditional support, that even if there were no other evidence than that of palæontology in its favour, I should feel compelled to adopt the hypothesis of evolution. Happily, the future of palæontology is independent of all hypothetical considerations. Fifty years hence, whoever undertakes to record the progress of palæontology will note the present time as the epoch in which the law of succession of the forms of the higher animals was determined by the observation of palæontological facts. He will point out that, just as Steno and as Cuvier were enabled from their knowledge of the empirical laws of coexistence of the parts of animals to conclude from a part to the whole, so the knowledge of the law of succession of forms empowered their successors to conclude, from one or two terms of such a succession, to the whole series, and thus to divine the existence of forms of life, of which, perhaps, no trace remains, at epochs of inconceivable remoteness in the past.

NOTES

MOST of the foreign Governments have appointed their delegates to the International Congress of Electricians at Paris. Among the German delegates are M. Wiedemann, editor of *Wiedemann's Annalen*, Helmholtz, Du Bois-Reymond, and Weber, who, as we stated in our last issue, has received a medal in commemoration of the fiftieth anniversary of his professoriate in Halle. The name of Weber is the only one among living men which has been inscribed on the walls of the Palais de l'Industrie. The original instrument which Weber invented with Gauss in 1833 is exhibited in the German section. Amongst the names of English men of science who are said to have been delegated by the English Government are those of Sir William Thomson and Dr. Siemens. One, if not the principal, object of the deliberations of the Congress will be the adoption of a universal system of electric and magnetic measures, as advocated by the British Association. The work of the Commission which has been appointed by it will be discussed, and practical suggestions are to be made relating to it. It is supposed that the electrical and magnetic units are to be considered as a sequel to the metric system of weights and measures. Another question will relate to the laying of submarine cables, viz., the establishment of an international codex of signals for telegraphic steamers, and the necessity of adopting rules for parallel or transversal lines, liable to endanger the existing ones. But it does not appear that any allusion is to be made to the neutralisation in war time, although it has been recommended by M. Barthélemy St. Hilaire, the Minister of Foreign Affairs. All the sittings are to be private, to the exclusion of the public and Press, except a few lectures given by some members on selected topics. *Procès-verbaux* are to be written and published by a select body of authorised secretaries.

THE telephonic audition of the Opera at the Paris Electrical Exhibition is very popular. Not less than 1500 people are admitted by relays of twenty-four, during two minutes at a time, to enjoy it every opera night. It was contemplated to transmit the performances from the Théâtre Français on the same principle, but it has not been successful. The receipts of the Exhibition exceed 4000*l*. daily.

A SIXTH electrical paper has been started in Paris. It is a large folio issued every Saturday, and called *Moniteur officiel de l'Électricité*. It is conducted by M. Barbieny, a gentleman connected with the political Press, and who has founded several periodicals. Electricity has now more papers in Paris than general science.

THE will of the late Sir Josiah Mason of Birmingham ha just been proved. The personal estate was sworn to be of the value of 56,729*l*. The testator had no real property, having in his lifetime disposed of his real estate, worth upwards of 10,000*l*. per annum, either to his orphanage or college trustees, or his great nephew. After legacies and bequests amounting to 7500*l*., the whole of the testator's personal estate by law applicable to charitable purposes is bequeathed to the trustees of the Mason Science College, for the general purposes of the institution. Elaborate provisions are made for charging the debts, annuities, and legacies on the property which cannot legally be bequeathed to charitable purposes, so as to secure the whole residue for the college.

DR. ARCHIBALD BILLING, M.A., F.R.S., the author of the "First Principles of Medicine," died in London on Friday, at the age of ninety. The deceased physician, who was a native of Ireland, was born in 1791, and was educated at Trinity College, Dublin, and at Oxford, graduating at the first-named University. While engaged at the London Hospital, he instituted the series of chemical lectures which have since become an established feature of the medical school at that institution, but resigned his appointment at the close of 1836, upon the establishment of the University of London. Dr. Billing was a large contributor to the medical Press. He was a member of a large number of learned societies, both in this country and on the Continent.

A CONVENTION of American photographers has recently concluded its sittings at New York. Before separating the members appointed a committee to consider the feasibility of forming an International Photographic Association, and to confer with foreign societies with that view. A report upon the subject will be presented at the next meeting of the Convention, which is to take place at Indianopolis.

THE American Association for the Advancement of Science, at its meeting last month in Cincinnati, took action in reference to the scandal of American degrees, by resolving to unite with the American Philological Association in presenting a memorial to all colleges in the United States empowered to confer degrees, stating the objections to conferring the degree of Ph.D. *honoris causâ*, and praying them to discontinue the practice, if it exists. It seems that the reprehensible practice has been growing of late in the United States. There are, it would seem, in the United